

REMARKS

Reconsideration and allowance of this application, as amended, is respectfully requested.

This Amendment is in response to the Office Action dated December 28, 2005. Appreciation is expressed to the Examiner, Michelle Crowell and her supervisor, Mr. Parviz Hassanzadeh for their courtesy and helpfulness during a personal interview conducted in this matter on April 19, 2006, at which interview the applicant's representative, Mr. Masaki Fujita also attended. During the course of this interview, the amending of claim 75 in the manner presented here to emphasize distinctions over the cited Prior Art for the reasons set forth below was discussed. In considering these arguments, the Examiner's indicated that they would have to reconsider the present rejection and conduct a further search since, as discussed below, the Mintz reference (USP 5,223,457) cited against claim 75, fails to meet the requirements of the means plus function language of the claim regarding the magnetic field forming means.

Reconsideration and allowance of the amended independent claim 75 and its previously pending dependent claims 76-78 is respectfully requested. By the present amendment, claim 75 has been amended to remove certain language regarding the intensity of the magnetic field produced so that the independent claim 75 can concentrate on the language set forth regarding the means plus function limitation of:

"A magnetic field forming means for forming a magnetic field designed to generate increased plasma at a portion within an outer periphery of said sample which is greater than the plasma at the center of the sample."

It is noted that the removed language regarding the intensity of the magnetic field has been set forth in new dependent claim 79, which will be discussed later in these remarks. Also, the present amendment eliminates the language of the size of the fine pattern etched by the plasma, and inserts this in a new dependent claim 80, which will also be discussed below. As such, as noted above, claim 75 is now specifically directed to emphasizing the important feature of the means plus function limitation of the magnetic field forming means to generate increased plasma density at the periphery of the sample in comparison with the plasma density generated at the center of the sample.

As discussed during the interview, this feature is specifically for the purpose of overcoming a problem of uneven plasma density which tends to naturally occur in prior art devices such that the plasma density at the center of the wafer tends to be higher than the plasma density at the periphery of the wafer. As discussed in the Specification of the parent USP 6,197,151 (which Specification will be referred to for simplicity), column 3, line 55 et seq. sets forth with regard to the prior art:

"There is a disadvantage in that the plasma density is higher in the central portion of the sample and lower in the peripheral portion of the sample, and accordingly, uniformity in the processing all over the surface of the sample is degraded. "

The Specification goes on to note, that although certain steps have been taken to try to avoid this in the past, these steps themselves lead to other disadvantages.

Accordingly, the present application offers a number of embodiments, such as those shown in Figs. 15-29, (referred to solely for purposes of example) for increasing the plasma density at the peripheral portion of the wafer being processed. In regard to the embodiment shown in Fig. 15, for example, it is stated in column 24, line 33 et seq. of the '151 Specification that:

"In order to perform plasma-processing all over the surface of the sample highly accurately, cyclotron resonance effect of electrons is larger in the peripheral portion where the portion outside of the peripheral portion than in the center so that generation of plasma becomes large in the peripheral portion or the portion outside of the peripheral portion of the sample than in the center of the sample."

In particular, the embodiment of 15 achieves this, as discussed beginning on column 24, line 43, by rotating the core 201. Figure 17 shows the results of this arrangement, with the magnetic field intensity, and the corresponding plasma density, being greater in the peripheral regions of the sample.

Figures 21 and 22 show another embodiment for achieving this same result, as discussed beginning on column 25, line 31 et seq. of the '151 patent. In particular, as noted in column 25, line 45 et seq.:

"The distribution of the magnetic field intensity of each portion of the sample surface can be adjusted by appropriately choosing the position and the diameter of the coils 210,. 220, so as to increase plasma generation in the periphery or the outer side of the periphery of the sample."

Still, another embodiment for achieving this is shown in Figs. 28 and 29. In this case, the coils 230 and 240 are arranged such that:

"The distribution of the magnetic flux B formed by the coil 230 and the direction of the magnetic flux B' formed by the coil 240 cancel each other in the central portion of the processing chamber 10, and superimpose in the peripheral portion and the outer portion of the peripheral portion of the processing chamber 10, as shown by the arrows. As a result, the distribution of the magnetic field intensity at each position of the sample surface becomes as shown in Fig. 29. "

As such, the Specification clearly supports the language set forth in the present claim 75 for a magnetic field forming means for forming a magnetic field "designed to generate increased plasma at a portion within an outer periphery of said sample which is greater than the plasma at the center of said sample." As discussed above,

this serves to provide a much more even plasma processing performance than the prior art.

In the Office Action, claim 75 has been rejected over a combination of Collins (USP 5,300,460), Ohmi (USP 5,272,417) and Lenz (USP 5,609,720) in view of Mintz (USP 5,223,457). With regard to this, the Mintz reference is particularly relied on for the teachings of the generation of a magnetic field of less than 30 gauss (which limitation had previously been in claim 75, and is now in new claim 79). As stated in the Office Action on page 10, paragraph 11, the Mintz reference is cited to teach generation of such a magnetic field which, in the case of Mintz, is for the purpose of deflecting plasma ions and preventing wafer contamination. More specifically, as discussed in column 6, lines 51 through 63, Mintz provides a pair of electromagnetic coils 114 which produce a very weak magnetic field which is:

"sufficient to prevent plasma ions from impacting the walls with sufficient energy to desorb contaminants from those walls."

As such, the purpose of the electromagnetic coils 114 and 115 in Mintz is completely different than the function of the present invention defined in claim 75. As noted above, claim 75 specifically defines that the magnetic forming means has the function (in a means plus function format) "for forming a magnetic field designed to generate increased plasma at a portion within an outer periphery of said sample which is greater than the plasma in the center of the sample. " It is respectfully submitted that this specific means plus function limitation is completely lacking from the Mintz reference. Quite to the contrary, Mintz is only directed to generating a very weak magnetic field for the purpose of deflecting plasma ions away from the walls of the plasma reactor to avoid contamination.

An important aspect of the difference between the electromagnetic coil structure of Mintz and the present claimed invention is that Mintz specifically states that the electromagnetic coils generate a magnetic field that is so weak that it does not effect process uniformity. This is specifically set forth in Mintz in column 6, line 56 et seq. which states:

"Unlike in the prior art, it is not necessary that these fields be uniform at the surface of the wafer because they are too weak (on the order of 1-20 gauss at the surface of the wafer) to significantly affect process uniformity."

In the present invention, on the contrary, as defined in claim 75, the purpose is specifically to affect process uniformity by ensuring that the plasma density at the periphery of the wafer is greater than the plasma density at the center of the wafer. Clearly, Mintz teaches directly away from having sufficient magnetic field strength to achieve such altering of the plasma processing uniformity. For this reason, it is respectfully submitted that Mintz fails to teach anything which would suggest the complete modification of the other cited prior art to Collins, Ohmi or Lenz to arrive at the invention defined by claim 75 and its dependent claims 76-78. Therefore, reconsideration and removal of the rejection of independent claim 75 and its dependent claims 76-78 is respectfully requested.

Reconsideration and allowance of dependent claim 79 is also respectfully requested. With regard to this, it is noted that the Office Action sets forth a rejection under 35 USC §112, first paragraph (paragraphs 2 and 3) based upon the statement that the Specification fails to teach the feature of generating a magnetic field having an intensity on the sample smaller than 30 gauss. In response to this, applicants respectfully note that this limitation, now found in claim 79, is, indeed set forth in the

Specification. For example, again referring to the Specification of the parent USP 6,197,151, column 25, line 42 et seq. states:

"Therefore, the apparatus is constructed so that the magnetic field intensity on the sample 40 becomes smaller than 30 gauss, preferably, smaller than 15 gauss."

This is also set forth, for example, in column 7, line 19 et seq., which states:

"The magnetic field intensity on the surface of the sample table mounting the sample parallel to the sample table is set below 30 gauss, preferably, below 15 gauss."

Accordingly, with regard to newly presented claim 79, reconsideration and removal of the 35 USC §112, first paragraph, rejection set forth in paragraphs 2 and 3 of the Office Action is respectfully requested.

Similarly, reconsideration and removal of the 35 USC §112, first paragraph rejection of the language in claim 75 regarding the etching of a fine pattern of 0.2 μm or smaller on the sample (now found in new claim 80) is also respectfully requested. With regard to this, paragraph 4 of the Office Action points out that the discussion concerning this specific dimension is set forth in column 3, lines 33-37 of the Specification (under the heading of "Background of the Invention", but not later in the Specification, for example, under the heading of the "Summary of the Invention.") With regard to this, it is noted that the Summary of the Invention in column 5, line 7 et seq., does, in fact, use the term "performing precise manufacturing of a fine pattern on a large size sample having a diameter of 300 mm or more by obtaining a large-sized and uniform plasma." In conjunction with this, it is respectfully submitted

that the definition of "fine pattern" is effectively set forth in the virtually identical language set forth in column 3, line 33 et seq., that with regard to a prior art technique:

"It is difficult to manufacture a fine pattern of 0.2 μm or smaller on a wafer having a diameter larger than 300 mm uniformly and quickly with a high selectivity of the etching material to the base material."

In other words, the language in column 3 of the parent '151 patent effectively sets forth from its very phraseology, that it is an object of the present invention to overcome the difficulty in the prior art with regard to fine patterns of 0.2 μm or smaller on a wafer having a diameter larger than 300 mm. Therefore, it is respectfully submitted that one of ordinary skill in the art reading the subsequent language regarding the Summary of the Invention in column 5, line 7 et seq. would certainly interpret the term "fine pattern" on a large size sample having a diameter of 300 mm or more as referring to the previous mention of a "fine pattern" of 0.2 μm or smaller. Therefore, reconsideration and removal of the 35 USC §112, first paragraph, rejection regarding this language in claim 80 is also respectfully requested.

If the Examiner believes that there are any other points which may be clarified or otherwise disposed of either by telephone discussion or by personal interview, the Examiner is invited to contact Applicants' undersigned attorney at the number indicated below.

To the extent necessary, Applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in fees due in connection with the filing of

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this paper, including extension of time fees, to the Deposit Account No. 01-2135 (Docket No. 520.35237VX3), and please credit any excess fees to such Deposit Account.

Respectfully submitted,
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